DSTAR
DISTRIBUTION SYSTEMS TESTING, APPLICATION, AND RESEARCH

DSTAR Newsletter | Volume 2 | November 2013

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UPCOMING EVENTS

- **GE Digital Energy's Americas Software Summit**
  2/10/14–2/14/14
  Orlando, FL
- **DSTAR Annual Meeting**
  4/30/14–5/1/14
  Richmond, VA

DSTAR Software: Immediate Impact Through Collaboration

Lavelle Freeman
Lead Program Manager

DSTAR, GE

Devin Van Zandt
Sr. Technical Advisor,

DSTAR, GE

Electric utilities in the US are faced with a unique and often conflicting set of challenges in their current operating environment. They are under increasing pressure to design "smarter" systems and improve operational efficiency, even as the integrity of their physical infrastructure declines, and human resources are more constrained. In order to meet these challenges, today's distribution designer must be equipped with tools that will help him/her do their job more efficiently.

To meet the need for modern engineering software tools, DSTAR has developed over 15 applications that are designed to be used with minimal training. These applications can be easily customized to the equipment and practices used by each member utility, allowing the ultimate user (for example, a design technician with limited engineering expertise) to apply the program with maximum efficiency and minimum complexity. Most importantly, the development of these applications has been guided directly by engineers and technicians from several DSTAR member utilities that use the software. Their experience and understanding of the technical issues is reflected in the design and layout of each software tool.

This unique collaborative structure has resulted in software applications that are used frequently and have undergone numerous changes to improve capability and usability. The DSTAR members who have participated in the development are vested in the process and, therefore, have taken an active role in maintaining the products as requirements have evolved. As we move forward into "smart" distribution system design and operation, a collaborative approach, exemplified by DSTAR, is nimble and flexible enough to develop new methods and software for planning the system of the future.

One of DSTAR's most heavily used software tools was initiated, developed, and enhanced collaboratively over several years with the member utilities. The tool, Secondary Electrical Design Software (SEDS), is routinely used by over 1500 engineers and designers at several utilities across the country, including Duke Energy, PacifiCorp, WE Energies, and SCANA. SEDS allows users to construct a secondary system design very quickly. Each DSTAR utility has developed a database with their own standard data for transformers, loads, and conductors. Once the system is laid out and data is inputted, the user can perform a voltage drop, flicker, or short circuit analysis.

Although the distribution system is a very dynamic portion of the utility system, and accounts for a substantial share of the utility's capital and operating expense, it has not generally received the same degree of research attention as the generation and transmission portions of the system. Many of the major issues facing individual distribution utilities today apply to the entire industry and can be more effectively solved collaboratively.

The DSTAR collaborative research and development model allows participants to leverage pooled funding, reduce their financial risk and gain wide industry acceptance of successful technology developments achieved through collaborative research and development efforts. The SEDS software is a product of this R&D model and has been used by DSTAR members for over 12 years to help them design efficient secondary systems. The SEDS optimization feature uses a novel approach to find a design that minimizes costs and losses while meeting user defined constraints. As distribution designers look for ways to lower costs and losses, tools like SEDS will play an increasing role in overall system design.

To learn more about our software, please visit our website:

http://www.dstar.org/research/focus-areas/

Anthony Katigbak
Engineer I,
Distribution Standards,

Duke Energy

Why DSTAR for Duke

My company's Distribution Standards team often fields questions from all sorts of folks, from line technicians to upper management. Sometimes, questions make their way to my team whose fallout can shake the very foundations of engineering practices and work methods established long ago.

More often than not, simpler questions come up like, "will it pull?" or, "will the lights blink?" Certainly, we can deflect everyday questions like these by responding with a Distribution version of RDFM (Read the Friendly Manual). However, DSTAR offers an even more user-friendly approach to questions like these: simple-to-use software.

So, "will it pull?" model a conduit system in DSTAR CPA (Cable Pulling Assistant), and you can find out. Based on your organization's cable and conduit parameters, users can define a conduit layout and determine whether cable can be successfully pulled through said run by quantifying cable tensions, sidewall pressure, and jamming. CPA's 3-D layout diagram shows your tabularly entered series of straight runs, sweeps, and field bends as a 3-D model while overlaying cable tension via colorful heat map.

> "DSTAR's software tools for designers have been useful for new engineers and technical staff at SCE&G. The software is cost-effective and has allowed the new designers to be productive sooner."
>
> – ***James Hammond***
> *Manager Electric Service Support,*
> *South Carolina Electric & Gas*

Once a user figures out a cable-and-conduit layout will, in fact, "pull", a user can then experiment with "what would make a layout fail?" Playing with the number or placement of sweeps or whether a crew should perform a forward or reverse pull, a user might be surprised at just how far cable can be pulled. Rules of thumb like "five sweeps per run" or "500 feet between pullboxes" may start appearing overly conservative in some circumstances. It may turn out that the only thing that limits a particular design is how many feet can be ordered on a reel.

How about, "will the lights dim excessively?" Enter DSTAR SEDS, or Secondary Electrical Design Software. SEDS allows users to select transformers, conductors and cable, customer load and devices, and coincidence factors to display a proposed layout and key electrical parameters such as conductor loading and customer voltage, all without having to plug in numbers from different charts into pesky equations.

SEDS can not only tell users that, "yes, there is a voltage flicker issue", but it can also tell a user "there is now a possible fault current issue" depending on how the flicker issue gets addressed. SEDS makes ensuring a design meets requirements for voltage drop, flicker, and fault current quick and easy.

Like "will the lights dim excessively?", "why are the lights dimming excessively?" comes up as a question, often during a power quality investigation. SEDS helps field personnel visualize where voltage concerns arise on an existing secondary circuit. With such information in plain view, and the secondary circuit modeled in SEDS, one can try out different solutions to a given voltage problem.

DSTAR is great for researching industry concerns and investigating the "next big thing", but DSTAR can also support your everyday issues. Use one of its software applications to standardize solutions to the small fry, and you can help your organization focus on the next big thing (or things).

Program 14 Update

Ed Owen
Technical Consultant

DSTAR

P14-8: Motor Problems Resolution and Avoidance – Update CRN Publication

Introduction

Utilities have long recognized that rural customers are in a special category with unique requirements not present when dealing with most of their residential or industrial customers. Power engineers have been working on these special requirements for more than a century. In 1925, Owen D. Young expressed it thusly:

"The electrification of the farm requires the cooperative effort of the farmer, the electric light and power company, and perhaps most of all, the electrical manufactures. The problem is difficult but it must be solved. Farms must be made attractive as a place to live and profitable as a business."

In the mid-1930s, the Rural Electric Associations (REAs) came into existence and leadership transferred to an agency of the US Government. By the early 1950s the vast majority of farms in the U. S. had electricity. Changing rural patterns have continued to evolve and solutions from the past are no longer as suitable as they once were.

CRN Publication

In 1995 the Cooperative Research Network (CRN) in Arlington, VA commissioned Stanley Consultants to investigate the needs of rural customers and produce a report that could be used by customer service engineers of distribution cooperatives as they worked with their rural customers. The report was well done for the needs when it was written.

Changing Rural Patterns / Changing Distribution Cooperatives

Since 1995 the American farm has changed significantly and meanwhile the distribution cooperatives which provide them with electricity have also changed. Distribution cooperatives are increasingly faced with industrial customers whose electric requirements are very different than those of a farming community. That service manual written in 1995 is no longer as helpful in facilitating communications between utility and their customers; both farmer and industrial. Many of the basics expressed in the older report are as true today as they were when it was written and should be preserved. However new types of motors and introduction of electronic power converters to farm applications have changed the picture radically for all parties. In addition a desire to reduce energy consumption has created issues not previously recognized.

The New Project

In 2013 DSTAR commissioned Ed Owen (GE Retired) working for GTC in Charlton, NY to update and expand the earlier CRN publication. With new types of electric motors in use and new (to rural customers) electronic power converters, those sections from the old report that deal with these topics are modified accordingly.

In 1837 Thomas Davenport from Brandon, Vermont is credited with two milestone achievements; building a practical electric motor and obtaining a US patent on it. For 50-years following Davenport's invention, most electric motors were designed using a solenoidal magnetic field. In 1886, both Nicola Tesla and Galileo Ferraris, working independently, introduced the concept of a rotating magnetic field within a few weeks of each other. The new rotating field principle quickly took over the field.

Today the new (old) solenoidal principle has come back into use. Which is it? What difference does it make? The report will address these questions.

Current Status of New Report

Much of the new report is now drafted. Work is proceeding with inputs from DSTAR members on expanding the case studies.

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Suresh Gautam
Technical Advisor

DSTAR, GE

Project Spotlight

WHAT IS COMING IN PROGRAM 15:

- **Developing tools/assessing best practices for storm damage prediction and estimated times of restoration**
- **Assessing and mitigating distribution impacts of PV (including PV analysis in SEDS)**
- **Monitoring and detecting underground faults – technology evaluation and best practices**
- **Volt/VAR optimization ideas**

As we begin to organize Program 15, we encourage you to look within your organization for needs, problems, and challenges that would lead to dynamic new ideas. We look forward to an exciting new phase of DSTAR. If you are not currently a member of DSTAR, now is the optimal time to get on board.

Battling Copper Theft: Solutions to a serious problem

Electric utilities have large amounts of copper installed on both overhead and underground equipment. Copper is an excellent conductor of electricity, resists corrosion, and is highly ductile and malleable. These properties make it ideal for operating safe, reliable, and efficient systems, making it a mainstay for almost all types of wiring.

Figure 1: Concern over Copper theft

The global demand of copper, especially from emerging economies like China and India, has increased substantially over the past several years. However, the supply has been unable to keep pace leading to rise in the price of copper. In the US, electric utilities observed an increase in the number of copper theft incidents in the years leading up to the economic downturn in 2008. Evidence suggests that the high price of copper, along with the poor state of the US economy in recent years, has led to an increase the number of copper theft incidents on energy delivery systems.

DSTAR members approved Project 14-7 to identify the best practices in the industry to deter copper theft. As part of the study, a survey was conducted among DSTAR member utilities and other non-member utilities to gather data on utility concern over copper theft, the scale of problem, its consequences, and best practices to deter theft. The responses provided some valuable insights into key drivers and deterrent measures.

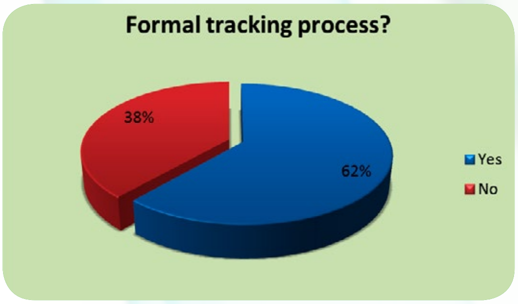

Figure 2: Formal Tracking Process

The survey confirmed that copper theft is indeed a significant problem for the respondents, with 92% reporting that they were "very" or "extremely" concerned (see Figure 1). However, despite the reported concern, more than a third of the respondents did not report a formal process to track incidents related to copper theft (see Figure 2).

When respondents were asked about the number of events and which piece of equipment or facilities were most susceptible to theft, the responses covered a very wide range. For example, the number of reported events varied from none to thousands over a span of several years. This variation could possibly be explained by the lack of tracking or how incidents are assigned or associated with a particular case of copper theft within a utility. Nonetheless, pole (ground wire and other pole mounted equipment) had the highest number of incidents, followed by neutral spans and substations (see Figure 3). The number of events was consistent with the degree of susceptibility to theft.

Project Spotlight

CURRENT PROJECTS IN PROGRAM 14:

- **14-1 thru 14-3:** Administrative Projects
- **14-4:** Surge Protection of Electronically-Controlled Devices Installed in Distribution Systems
- **14-5:** Cable Pulling Assistant Software Enhancement
- **14-6:** Best Practices for Integration of Utility Communications
- **14-7:** Survey of Best Practices for Copper Theft Deterrence
- **14-8:** Motor Problems Resolution and Avoidance – Update CRN Publication

For additional information on our current projects, please visit: **http://www.dstar.org/research/program/14**

Battling Copper Theft: Solutions to a serious problem (continued)

DSTAR Utilities have implemented several countermeasures to deter copper theft. Some of these include use of theft deterrent techniques like security cameras, alarms, better locks and fencing, and wire protection. Substituting alternative materials for copper and wire marking technologies have also been used as countermeasures in several utilities.

Figure 4 shows some popular countermeasures along with the number of respondents that implement them. The countermeasures had varying degrees of success for each company. Partnership with law enforcement had a greater reported success rate compared to other measures. Video surveillance had a mixed response, with three utilities reporting this approach to be most effective, but another three reporting it to be the least effective countermeasure they have implemented.

Figure 3: Susceptibility to Theft

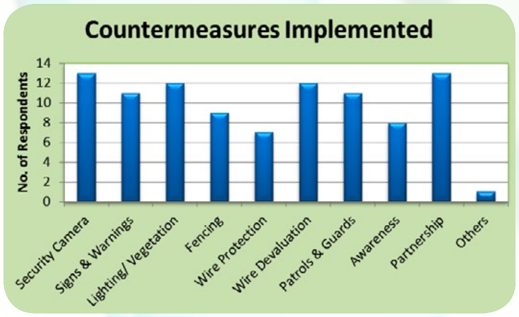

Figure 4: Countermeasures Implemented

Seven respondents provided the number of events and the total cost of repair for the events. Based on the response the average cost of copper theft was found to be approximately $3,500 per incident.

Copper theft is an issue of public safety and service continuity. Incidents related to theft impact the reliability and economy of power delivery. DSTAR P14-7 is a white paper that summarizes best practices to deter copper theft on power distribution systems. The study includes industry best practices, tools, and strategies to combat the copper theft problem.

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Matt Lecar
Operations Lead

DSTAR, GE

FEATURED WHITE PAPER EXECUTIVE SUMMARIES

- Distributed Generation Impact
- Ferroresonance Guildelines for Modern Transformer Application
- Padmounted Transformer Tank Fault Withstand Capabilities

Upon request via
matt.lecar@ge.com
415.391.7996 x3011

DSTAR E-HANDBOOK

Features include:

- Hyperlinked navigation
- Simple calculation sheets
- Strong search capability
- Portable PDF format
- Nominal R&D investment per utility

For more information **www.DSTAR.org**

Contact:

Lavelle Freeman
DSTAR Lead Program Manager
email: lavelle.freeman@ge.com
T: 518.385.3335

Rob Higbe
DSTAR Chairman
NRECA-CRN
email: rhigbe@santee.org
T: 843.355.0533

Emerging Trends: Improving Reliability Through Distribution Automation (DA)

The 2009 ARRA stimulus funded over $ 4.5 Billion in utility smart grid deployments, including numerous DA projects. According to the DOE, 48 of the 99 Smart Grid Investment Grants (SGIG) funded through ARRA targeted improvement in electric distribution system reliability, of which 42 included some form of automated feeder switching. Initial results from 4 of these projects, reported at the end of 2012, demonstrate the potential to reduce SAIDI and SAIFI by as much as 50% [DOE SGIG Progress Report, Dec., 2012].

Each level of incremental automation creates benefits in terms of SAIDI and SAIFI improvement, as the incidence, extent, and duration of sustained interruptions experienced by customers is reduced. But such improvement comes at a cost, due to the necessary incremental investment in both field automation hardware (sensors and switches) and the central software "brain" required to operate complex switching schemes. DSTAR P13-10 examined reliability impacts for a range of potential distribution automation investments in order to explore the business case for DA. We ran circuit simulations in Cymdist™ for a set of four hand-picked circuits (contributed by DSTAR members), representing rural, urban, and suburban topologies, and residential versus C&I loads. We then added varying levels of automation and estimated the reduction in outage time experienced by customers, utilizing automation strategies ranging from simple auto-reclosing/sectionalizing up through full Fault Detection Isolation and Restoration (FDIR). By inserting a single mid-point recloser, for example, we were able to model a 46% improvement in SAIDI and an 18% improvement in SAIFI for our urban circuit. At higher levels of investment, even greater improvements are possible, up to 68% in SAIDI and 59% in SAIFI in one case, but at significantly higher cost. As confirmed anecdotally, urban circuits, with high densities of customers affected and denser network connections to allow reconfiguration, often show the strongest "bang for the buck" from automation. Rural circuits with fewer customers and few tie points will not show the same impact in SAIDI and SAIFI.

Building on our exploration of the business case for DA, GE Energy Consulting is currently conducting a study for the GE Digital Energy Software Solutions business to examine the value of GE's PowerOn™ Restore (OMS), and Fusion and Control (DMS) tools in enabling and operating reliability-oriented DA. We are running simulations using a broader set of prototype circuits to develop a tool that will help GE customers quickly evaluate the value proposition for investment and target further investments to those circuits likely to see the best return. Results of this work will be presented in February at GE's Americas Software Summit (February 10-14 in Orlando).

WHAT IS DSTAR?

Distribution Systems Testing, Application, and Research (DSTAR) is a consortium of electric utilities, facilitated by General Electric International, Inc.'s Energy Consulting Department, sharing the results of distribution research. During its 25+ years of existence, DSTAR has focused on providing its member utilities with results that are directly applicable to everyday distribution design, operation, and maintenance.

DSTAR offers utilities a cost-effective and responsive means of addressing urgent problems that require near-term solutions. By cooperatively funding research with other utilities, each member utility substantially leverages its investment.

WHO IS DSTAR?

Ameren | American Public Power Association | Duke Energy | National Rural Electric Cooperative Association | PacifiCorp | South Carolina Electric & Gas | Southern Company | We Energies | Wisconsin Public Service